



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 11, 2021 – 05:30 PM EDT

PDB ID : 2HAU  
Title : Apo-Human Serum Transferrin (Non-Glycosylated)  
Authors : Wally, J.; Everse, S.J.  
Deposited on : 2006-06-13  
Resolution : 2.70 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.23.2  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.23.2

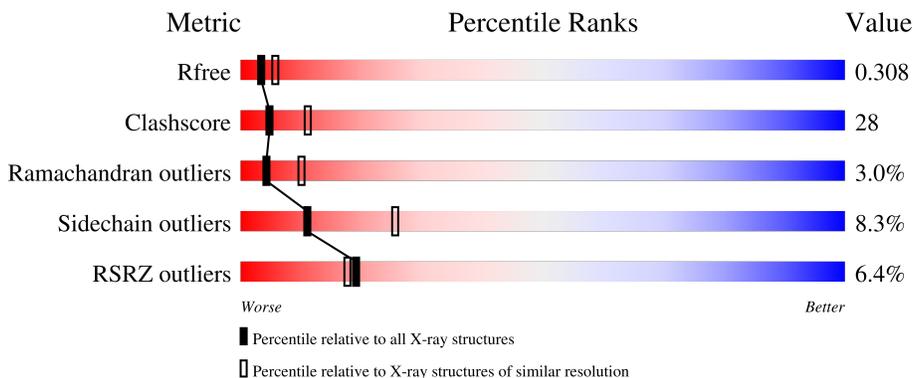
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	676	
1	B	676	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	CIT	B	9201	-	-	-	X
3	GOL	A	9101	-	-	-	X

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 10552 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

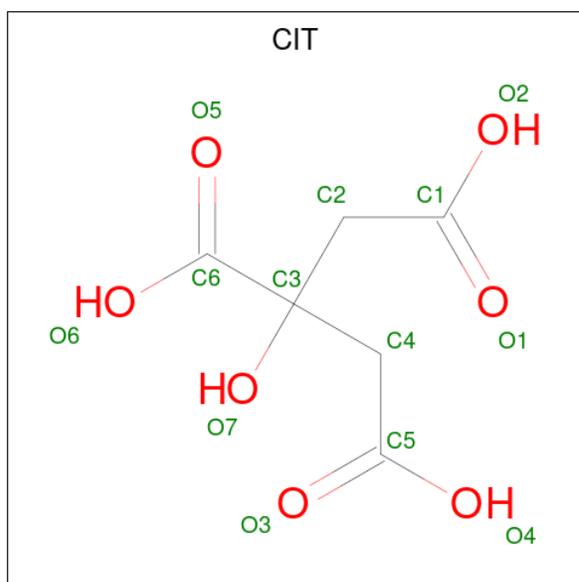
- Molecule 1 is a protein called Serotransferrin.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	676	5244	3291	907	999	38	9	0	0	0
1	B	676	5244	3291	907	999	38	9	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

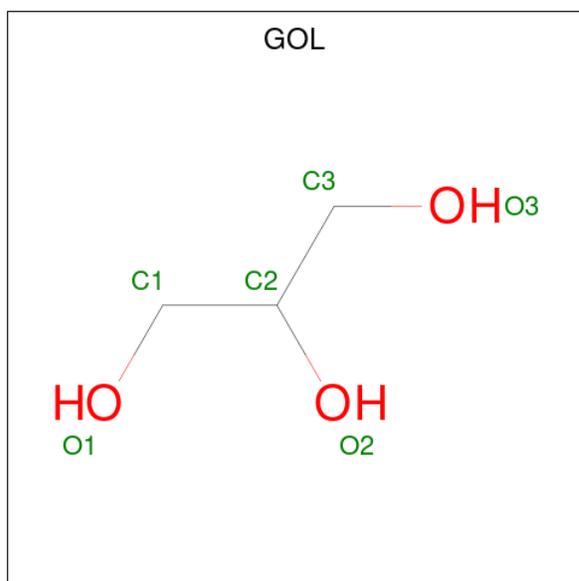
Chain	Residue	Modelled	Actual	Comment	Reference
A	26	MSE	MET	modified residue	UNP P02787
A	109	MSE	MET	modified residue	UNP P02787
A	256	MSE	MET	modified residue	UNP P02787
A	309	MSE	MET	modified residue	UNP P02787
A	313	MSE	MET	modified residue	UNP P02787
A	382	MSE	MET	modified residue	UNP P02787
A	389	MSE	MET	modified residue	UNP P02787
A	413	ASP	ASN	engineered mutation	UNP P02787
A	464	MSE	MET	modified residue	UNP P02787
A	499	MSE	MET	modified residue	UNP P02787
A	611	ASP	ASN	engineered mutation	UNP P02787
B	26	MSE	MET	modified residue	UNP P02787
B	109	MSE	MET	modified residue	UNP P02787
B	256	MSE	MET	modified residue	UNP P02787
B	309	MSE	MET	modified residue	UNP P02787
B	313	MSE	MET	modified residue	UNP P02787
B	382	MSE	MET	modified residue	UNP P02787
B	389	MSE	MET	modified residue	UNP P02787
B	413	ASP	ASN	engineered mutation	UNP P02787
B	464	MSE	MET	modified residue	UNP P02787
B	499	MSE	MET	modified residue	UNP P02787
B	611	ASP	ASN	engineered mutation	UNP P02787

- Molecule 2 is CITRIC ACID (three-letter code: CIT) (formula: C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>).



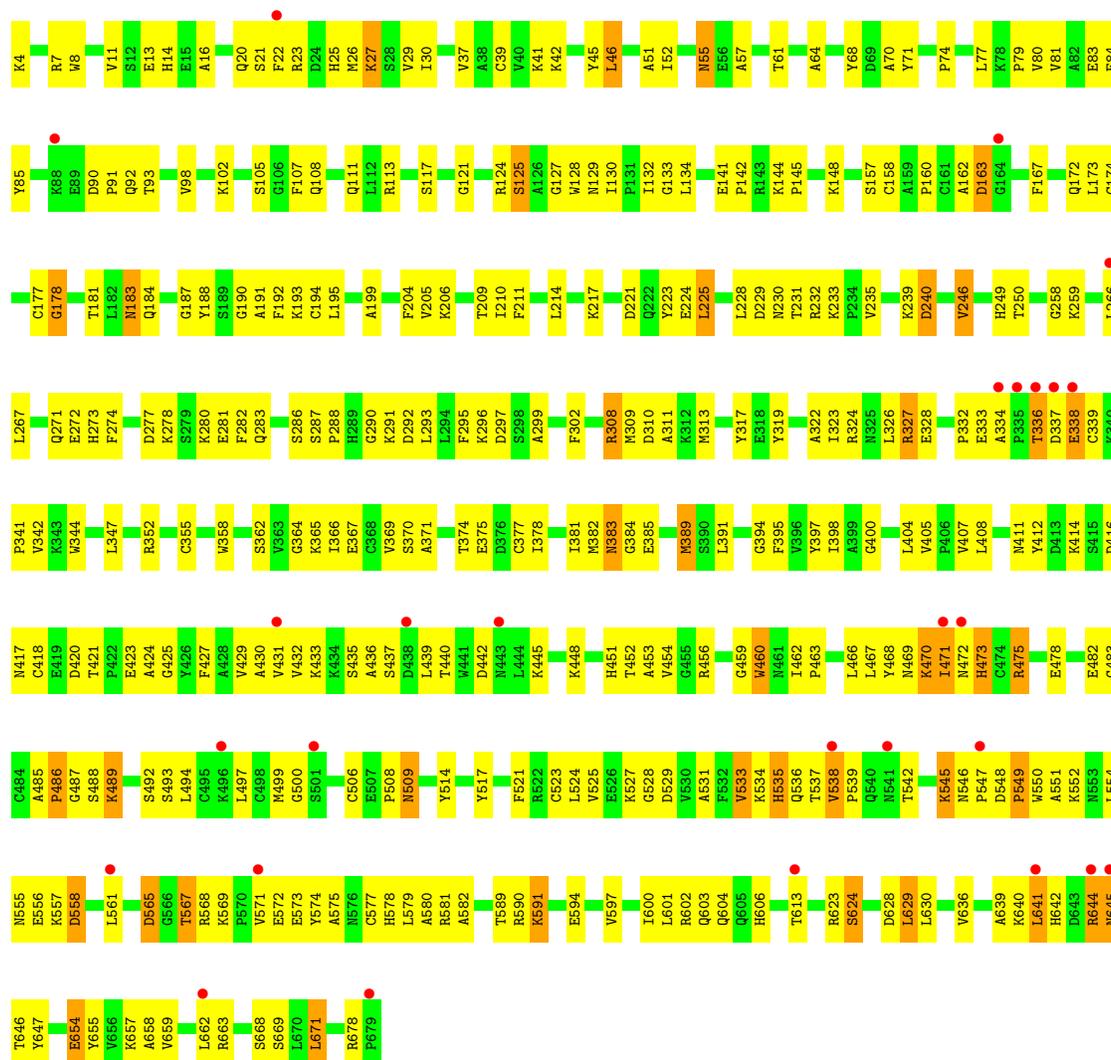
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 13 6 7	0	0
2	B	1	Total C O 13 6 7	0	0
2	B	1	Total C O 13 6 7	0	0
2	B	1	Total C O 13 6 7	0	0

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>			<b>ZeroOcc</b>	<b>AltConf</b>
3	A	1	Total	C	O	0	0
			6	3	3		
3	B	1	Total	C	O	0	0
			6	3	3		





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	88.00Å 102.16Å 197.04Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	15.00 – 2.70 55.25 – 2.57	Depositor EDS
% Data completeness (in resolution range)	(Not available) (15.00-2.70) 89.8 (55.25-2.57)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.88 (at 2.58Å)	Xtrriage
Refinement program	CNS	Depositor
R, $R_{free}$	0.273 , 0.324 0.270 , 0.308	Depositor DCC
$R_{free}$ test set	2554 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	60.1	Xtrriage
Anisotropy	0.347	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 39.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	10552	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	67.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.31% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CIT, GOL

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z  >5	RMSZ	# Z  >5
1	A	0.47	0/5354	0.66	1/7220 (0.0%)
1	B	0.48	0/5354	0.65	0/7220
All	All	0.48	0/10708	0.65	1/14440 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	621	LEU	CA-CB-CG	5.62	128.23	115.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5244	0	5064	296	0
1	B	5244	0	5064	283	0
2	A	13	0	5	1	0
2	B	39	0	15	1	0
3	A	6	0	8	0	0
3	B	6	0	8	0	0
All	All	10552	0	10164	577	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 28.

The worst 5 of 577 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:589:THR:HG21	1:A:597:VAL:HG21	1.29	1.12
1:B:105:SER:HB2	1:B:232:ARG:HH22	1.19	1.04
1:B:624:SER:HB3	1:B:629:LEU:HG	1.40	1.03
1:A:602:ARG:HH11	1:A:602:ARG:HB2	1.19	1.02
1:A:538:VAL:HB	1:A:539:PRO:HD3	1.42	1.00

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	674/676 (100%)	566 (84%)	89 (13%)	19 (3%)	5	11
1	B	674/676 (100%)	572 (85%)	80 (12%)	22 (3%)	4	8
All	All	1348/1352 (100%)	1138 (84%)	169 (12%)	41 (3%)	4	10

5 of 41 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	335	PRO
1	A	501	SER
1	A	628	ASP
1	B	162	ALA
1	B	338	GLU

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	569/560 (102%)	531 (93%)	38 (7%)	16	37
1	B	569/560 (102%)	513 (90%)	56 (10%)	8	18
All	All	1138/1120 (102%)	1044 (92%)	94 (8%)	11	25

5 of 94 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	308	ARG
1	B	470	LYS
1	B	317	TYR
1	B	383	ASN
1	B	506	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 38 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	325	ASN
1	B	536	GLN
1	B	361	ASN
1	B	451	HIS
1	B	645	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

6 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	GOL	A	9101	-	5,5,5	0.28	0	5,5,5	0.23	0
2	CIT	B	9201	-	3,12,12	2.36	2 (66%)	3,17,17	2.61	2 (66%)
2	CIT	B	9206	-	3,12,12	2.47	2 (66%)	3,17,17	2.29	2 (66%)
2	CIT	B	9204	-	3,12,12	2.45	1 (33%)	3,17,17	2.23	2 (66%)
2	CIT	A	9202	-	3,12,12	2.21	2 (66%)	3,17,17	2.20	2 (66%)
3	GOL	B	9102	-	5,5,5	0.47	0	5,5,5	0.30	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	GOL	A	9101	-	-	0/4/4/4	-
2	CIT	B	9201	-	-	0/6/16/16	-
2	CIT	B	9206	-	-	0/6/16/16	-
2	CIT	B	9204	-	-	0/6/16/16	-
2	CIT	A	9202	-	-	0/6/16/16	-
3	GOL	B	9102	-	-	0/4/4/4	-

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	9204	CIT	C2-C3	3.76	1.60	1.54
2	B	9201	CIT	C2-C3	3.45	1.59	1.54
2	B	9206	CIT	C2-C3	3.40	1.59	1.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	9202	CIT	C2-C3	2.97	1.59	1.54
2	B	9206	CIT	C4-C3	2.52	1.58	1.54

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	9201	CIT	C3-C4-C5	-3.82	108.87	114.98
2	A	9202	CIT	C3-C4-C5	-3.16	109.92	114.98
2	B	9204	CIT	C3-C4-C5	-2.96	110.25	114.98
2	B	9206	CIT	C3-C4-C5	-2.95	110.26	114.98
2	B	9206	CIT	C3-C2-C1	2.63	119.20	114.98

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	9206	CIT	1	0
2	A	9202	CIT	1	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	667/676 (98%)	0.53	58 (8%) 10 8	27, 66, 113, 122	0
1	B	667/676 (98%)	0.33	27 (4%) 38 37	26, 62, 102, 113	0
All	All	1334/1352 (98%)	0.43	85 (6%) 19 18	26, 64, 108, 122	0

The worst 5 of 85 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	335	PRO	9.4
1	A	559	TYR	8.1
1	B	336	THR	7.5
1	B	334	ALA	4.9
1	A	547	PRO	4.6

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	CIT	B	9201	13/13	0.64	0.41	98,101,103,104	0
2	CIT	B	9204	13/13	0.68	0.25	111,112,115,115	0
3	GOL	B	9102	6/6	0.73	0.26	93,97,97,97	0
3	GOL	A	9101	6/6	0.74	0.46	101,101,101,102	0
2	CIT	A	9202	13/13	0.75	0.20	104,106,107,107	0
2	CIT	B	9206	13/13	0.78	0.27	115,116,116,117	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.